

WILL-2: Bluewater Creek approx 1 mi upstream of confluence with TN River (Lauderdale Co 34.82273/-87.40888)

BACKGROUND

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program [now known as the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM's 2012 Monitoring Strategy (ADEM 2012).

In 2015, ADEM monitored the Bluewater Creek tributary embayment of Wilson Reservoir as part of the basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Bluewater Creek embayment (WILL-2) during the 2015 growing season (Apr-Oct). This is the fourth basin assessment of the Tennessee River since ADEM began sampling. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson's trophic state index (TSI)] from 2015 were compared to ADEM's previous data and established criteria.



Figure 1. Photo of Bluewater Creek at WILL-2

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Bluewater Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* stream located in the Western Highland Rim ecoregion (71f). Based on the 2006 National Land Cover Dataset, land use within the 139 mi² watershed is predominantly agriculture [hay/pasture (45%) and crops (8%)] (Fig. 3). As of January 28, 2016, ADEM has issued a total of 40 NPDES permits within the watershed. Four of those permits are located within 10 mi of the station (Figure 2).

SITE DESCRIPTION

The Bluewater Creek embayment at WILL-2 is located just south of Elgin, AL, on the northern side of the Tennessee River just downstream of the Joe Wheeler Reservoir Dam. The embayment has a mean bottom depth of 4.9 m (Table 2) at the sampling location and is surrounded by residential houses.

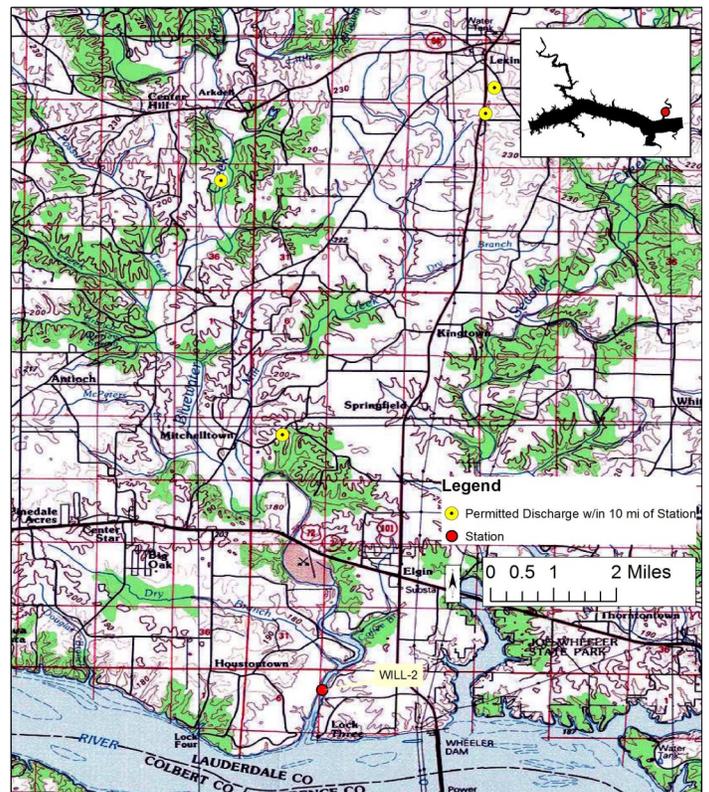


Figure 2. Map of Bluewater Creek embayment of Wilson Reservoir. Though additional permitted facilities may occur in the watershed (Table 1), only those discharges within 10 miles upstream of the station are displayed on the map.

METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2015 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

Table 1: Summary of Watershed WILL-2

Basin		Tennessee R
Drainage Area (mi ²)		139
Ecoregion ^a		71f
% Land use		
Open Water		<1%
Developed	Open Space	6%
	Low Intensity	1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	27%
	Evergreen Forest	2%
	Mixed Forest	4%
Shrub/Scrub		5%
Herbaceous		1%
Hay/Pasture		45%
Cultivated Crops		8%
Wetlands		
	Woody	2%
	Emergent Herb.	<1%
# NPDES outfalls ^b		
TOTAL		40
Construction Stormwater		32
Mining		0
Small Mining		0
Industrial General		6
Industrial Individual		0
No Exposure		0
Municipal		0
Underground Injection Control		2

a. Western Highland Rim

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

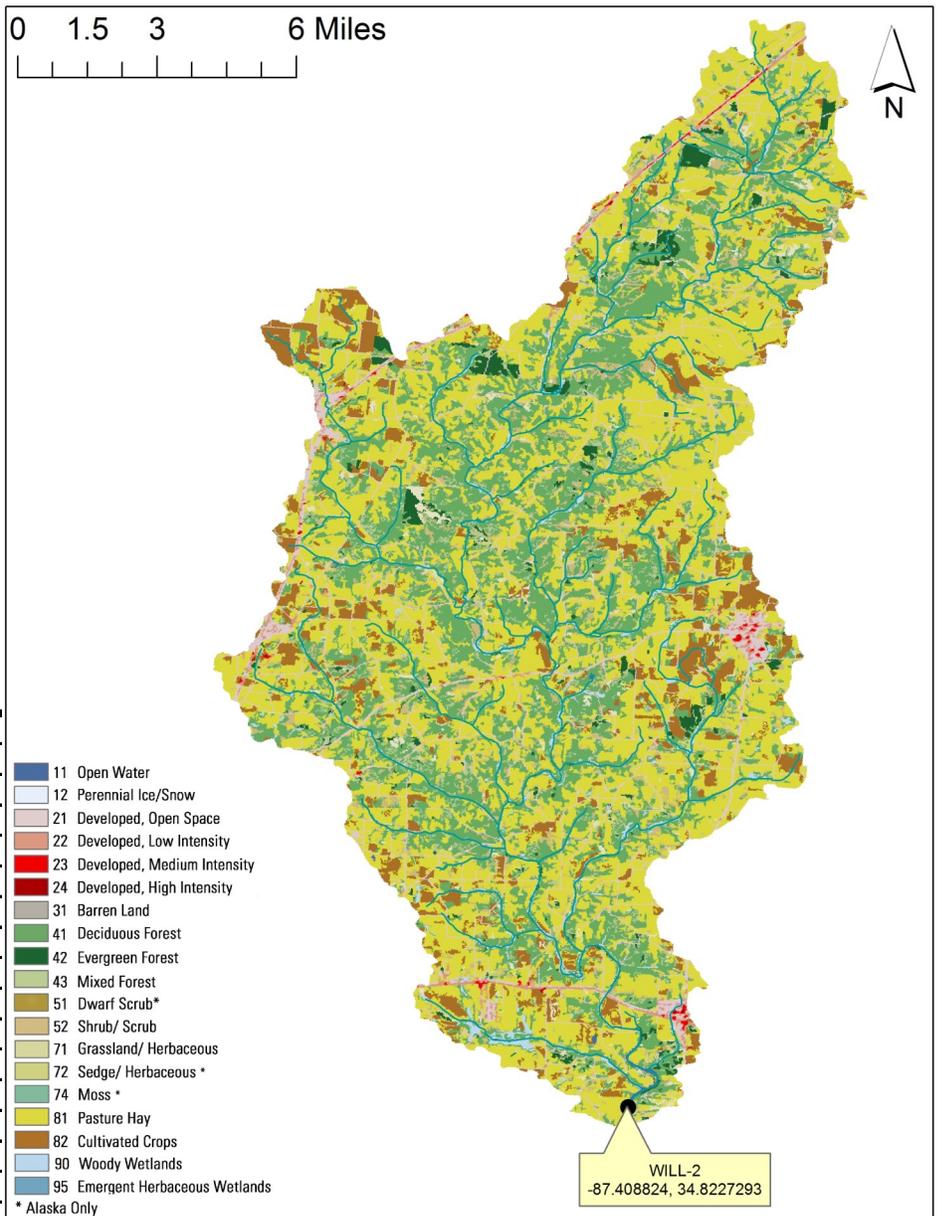


Figure 3. Land use within the Bluewater Creek watershed at WILL-2.

RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir-wide so all embayment reports on the same reservoir could be compared.

The mean growing season TN value was higher in 2015 than in previous years sampled (Fig. 4). Monthly TN concentration was highest in August.

Contrary to mean TN concentration, the mean growing season TP concentration was lower in 2015 (Fig. 4). Monthly TP concentration was highest in August.

In 2015, the growing season mean chl *a* value was higher than 2013 (Fig. 4). Monthly chl *a* concentrations peaked in September then dropped sharply in October.

Mean TSI was eutrophic in each year sampled since 2003. Monthly TSI in Bluewater Creek was oligotrophic in April, mesotrophic May-June and October, and eutrophic July-September (Fig. 4).

The mean growing season TSS value was higher in 2015 than 2013 (Fig. 5). Monthly TSS concentration was highest in October and low most other months sampled.

The DO concentration in the WILL-2 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

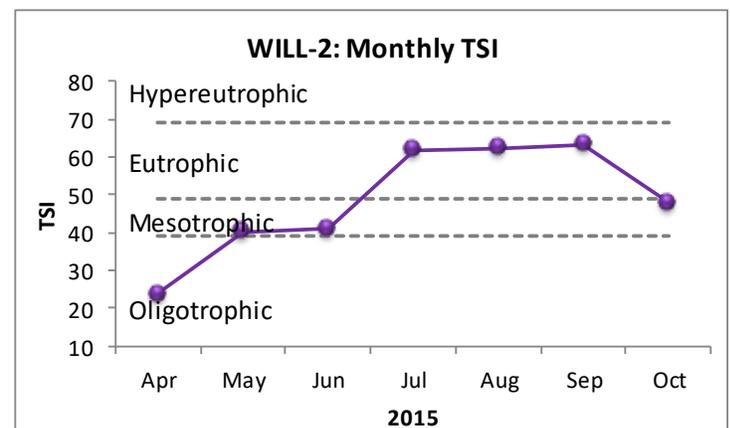
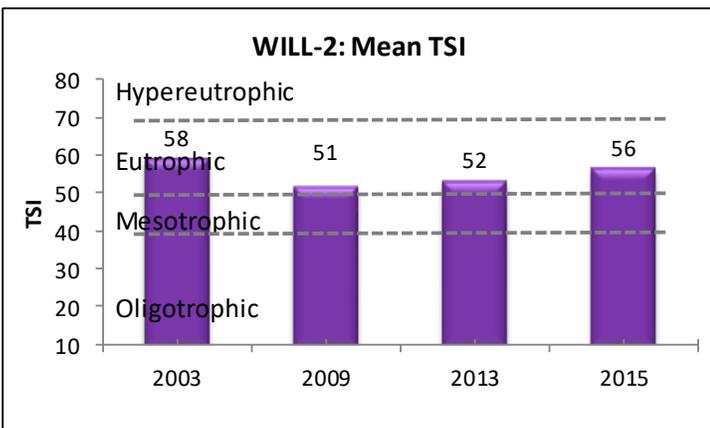
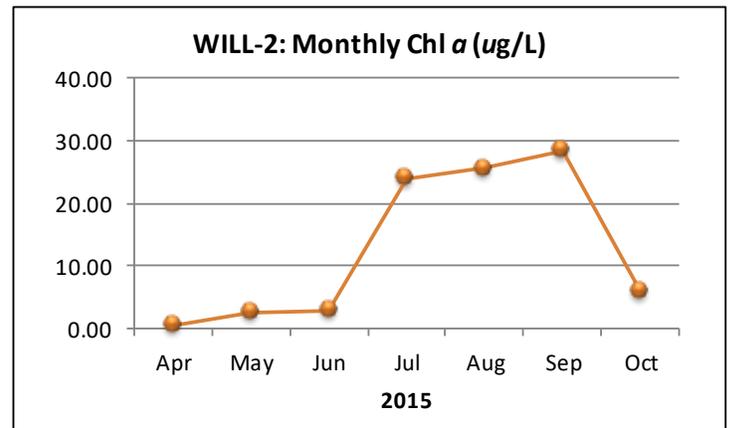
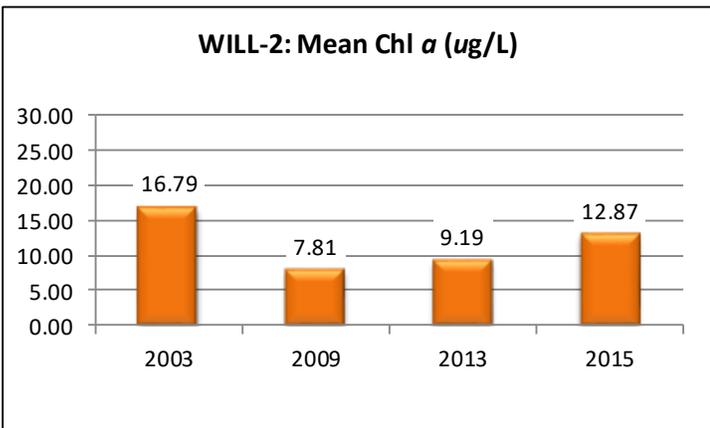
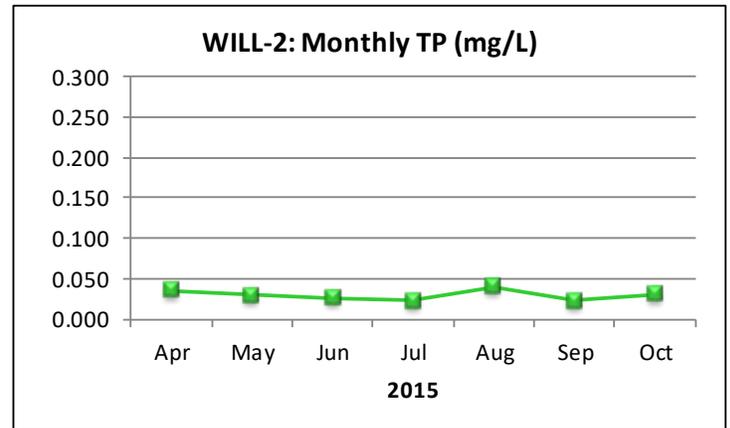
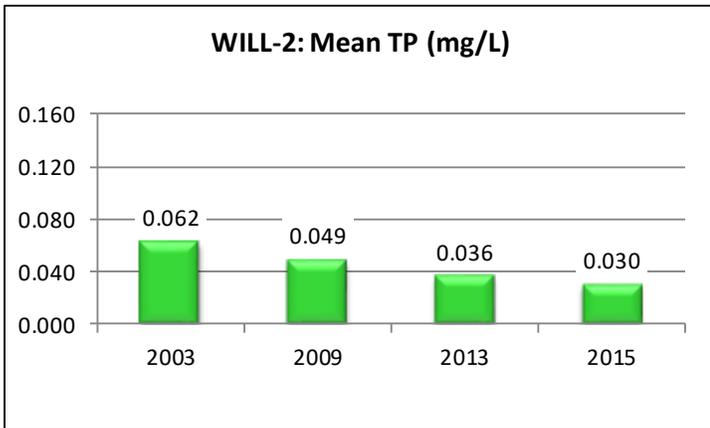
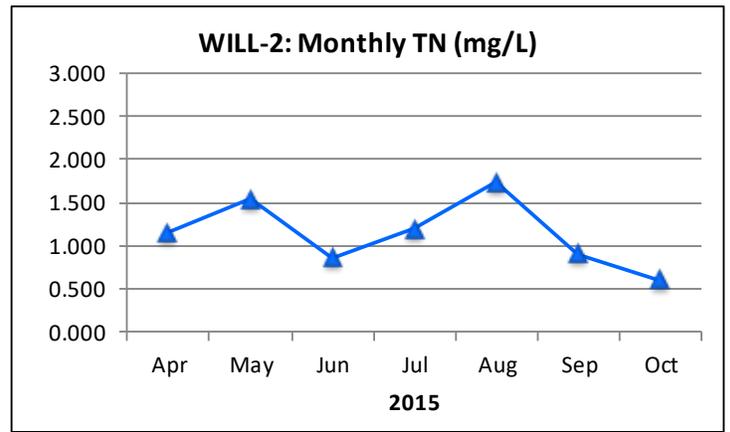
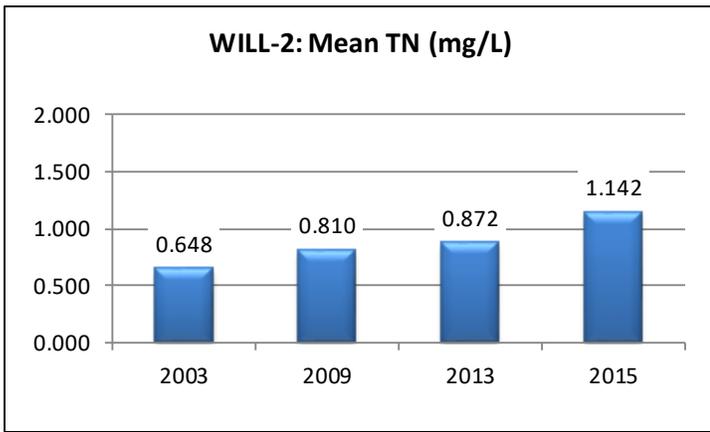


Figure 4. Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl a and TSI measured in the Bluewater Creek embayment of Wilson Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

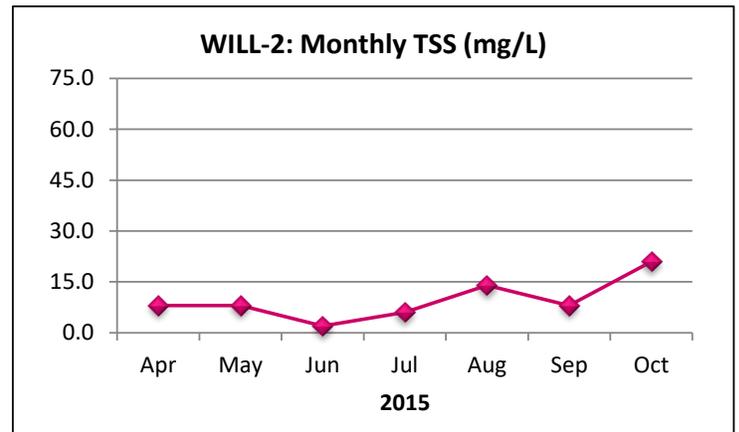
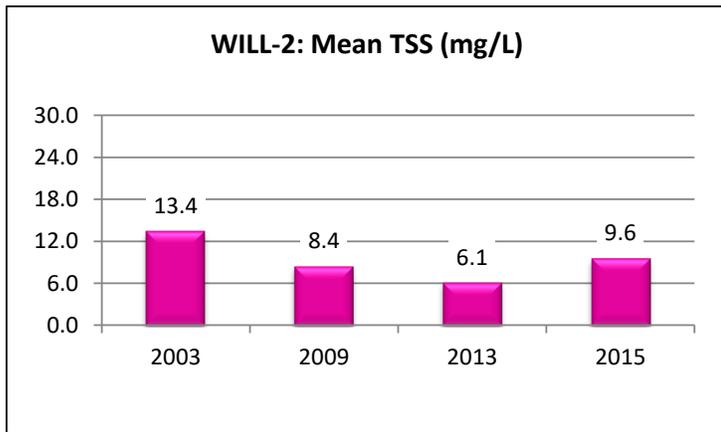


Figure 5. Mean growing season and monthly TSS measured in the Bluewater Creek embayment of Wilson Reservoir.

Table 2. Summary of water quality data collected April-October, 2015. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

WILL-2	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	5.9	11.2	7.8	7.9	2.0
Total Dissolved Solids (mg/L)	7	56.0	96.0	75.0	74.9	15.4
Total Suspended Solids (mg/L)	7	2.0	21.0	8.0	9.6	6.2
Hardness (mg/L)	4	37.1	80.0	58.4	58.5	17.5
Alkalinity (mg/L)	7	32.9	75.5	54.7	56.0	13.8
Photic Zone (m)	7	2.33	3.92	3.49	3.26	0.58
Secchi (m)	7	0.98	1.14	1.04	1.05	0.05
Bottom Depth (m)	7	4.6	5.4	4.9	4.9	0.3
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.007	0.083	0.023	0.028	0.030
Nitrate+Nitrite Nitrogen (mg/L)	7	0.058	0.873	0.280	0.389	0.284
Total Kjeldahl Nitrogen (mg/L)	7	0.277	1.510	0.854	0.753	0.427
Total Nitrogen (mg/L)	7	0.603	1.733	1.150	1.142	0.395
Dis Reactive Phosphorus (mg/L) ^J	7	< 0.002	0.015	0.006	0.008	0.006
Total Phosphorus (mg/L)	7	0.023	0.040	0.029	0.030	0.006
CBOD-5 (mg/L) ^J	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.5	6.8	3.8	4.7	1.4
Biological						
Chlorophyll a (mg/m ³)	7	< 1.00	28.50	5.87	12.87	12.48
E. coli (MPN/DL) ^J	3	1	10	4	5	4

J= one or more of the values is an estimate; N=# samples.

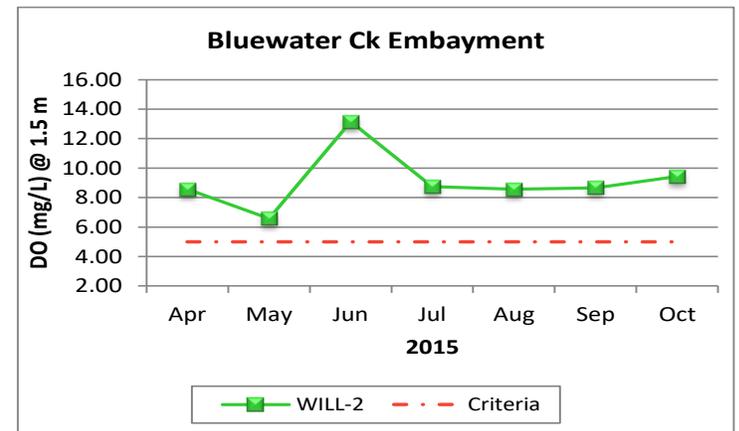


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Bluewater Creek embayment station of Wilson Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

- ADEM. 2015. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
- ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. <http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy>
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Carlson, R.E. 1977. A trophic state index. *Limnology and Oceanography*. 22(2):361-369.
- Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. *Journal of Water Pollution Control Federation* 59(4):222-227.

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